

81 A Producer's Source of Energy



Organisms that use energy from the sun to make food are known as producers. These include plants that you are familiar with, such as trees and grass, as well as organisms that live in the ocean, such as phytoplankton. Most phytoplankton are microscopic but they have a very big role in earth's ecosystems. They produce oxygen and provide energy for all living creatures—for the consumers that eat plants, the consumers that eat animals that eat plants, and the decomposers that live off dead plants and animals. They do this by means of photosynthesis, a process by which plants use the energy from sunlight to convert carbon dioxide and water into food for themselves (and indirectly, for consumers). During this process, plants release oxygen gas into the atmosphere. Photosynthesis can be described by the following word equation:

carbon dioxide + water $\xrightarrow{\text{sunlight}}$ food + oxygen

Is light necessary for photosynthesis? How important is sunlight to an ecosystem? In this activity, you will use the indicator bromthymol blue (BTB) to collect evidence for the role of light in photosynthesis.

CHALLENGE

How do scientists study the role of light in photosynthesis?



MATERIALS



For the class

light source (such as lamps or windows that receive good natural light)



For each group of four students

2–5 pieces of *Elodea* (*Anacharis*) (about 6 cm in length)

1 cup of water

1 dropper bottle of bromthymol blue (BTB)

1 straw

4 clear plastic vials with caps

1–4 pieces of aluminum foil

1 30-mL graduated cup

1 metric ruler (optional)



For each student

1 Student Sheet 81.1, "Recording Results"

PROCEDURE

Part A: Collecting Evidence



1. If you have completed previous units of *Issues and Life Science*, review your notes from Activity 17, "Gas Exchange," and Activity 39, "Cells Alive!" Use your notes to complete Tables 1 and 2 on Student Sheet 81.1, "Recording Results." If you haven't completed these activities, your teacher will help you fill in the tables.
2. Fill a plastic cup half-full of water. (Your teacher may have already done this.) Add 15 drops of BTB.
3. Have one person in your group use a straw to blow into the BTB solution until it stops changing color. Record this as the initial BTB color in Table 3 of Student Sheet 81.1.
4. Place a piece of *Elodea* into one of the vials. Carefully fill the rest of this vial with your BTB solution. Cap the vial tightly and place it in the light. **Caution:** Do not put your vial in a place that is extremely warm.
5. Fill a second vial with the same BTB solution only. Cap this vial tightly and place alongside the first vial.
6. With your group, discuss what you think might happen. Record your prediction in your science notebook.

7. After at least 45 minutes (or during your next class period), observe your vials. Use your observations to complete Table 3 of Student Sheet 81.1, as well as Analysis Questions 1 and 2.

Part B: The Role of Light

8. Design an experiment to investigate the role of light in plant photosynthesis.

Hint: Use the introduction to the activity and your results from Part A to help you.

When designing your experiment, think about the following questions:

- What is the purpose of your experiment?
 - What variable are you testing?
 - What variables will you keep the same?
 - What is your hypothesis?
 - How many trials will you conduct?
 - Will you collect qualitative and/or quantitative data? How will these data help you to make a conclusion?
 - How will you record these data?
9. Record your hypothesis and your planned experimental procedure in your science notebook.
 10. Make a data table that has space for all the data you need to record. You will fill it in during your experiment.
 11. Obtain your teacher's approval of your experiment.
 12. Conduct your experiment and record your results.

EXTENSION 1



Observe a capped vial containing a plant in BTB solution at different times of the day. What color is the solution first thing in the morning? At lunch-time? Explain your observations. What process may be taking place in plants at night?

ANALYSIS

Part A: Collecting Evidence

1. What was the purpose of the vial containing only BTB solution?
2. In the introduction to this activity, you were told that plants need carbon dioxide during photosynthesis. What evidence do you have from Part A of your investigation to support this claim?

Part B: The Role of Light

3. Describe your experimental results. Use the word equation at the beginning of this activity to help explain your results.
4. Explain the role that light plays in photosynthesis. How do your results provide evidence for your explanation?
-  5. A second-grader comes up to you and says, “We just learned that the sun made all the stuff in my lunch. But my lunch was a tuna sandwich.” Using language a second-grader would understand, explain how the sun was the original source of the energy in the tuna sandwich. Then try out your explanation on a child you know!
-  6. Think back to how the lake ecosystem described in Activity 79, “Eating for Energy,” was affected by zebra mussels. Using your understanding of photosynthesis and ecosystems, explain why a decrease in phytoplankton allows more aquatic plants to grow on the lake bottom.

EXTENSION 2

Your experiment looked at the *inputs* needed by a plant for photosynthesis. Design another experiment to collect evidence for the *outputs* of photosynthesis. Describe what materials you would need to perform this experiment, and what data you would collect.